REVIEW ON FABRICATION AND MODAL ANALYSIS OF E-GLASS WOVEN ROVING COMPOSITE PLATE

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Abstract

Composites are one of the most widely used materials because of their adaptability to different situations and the relative ease of combination with other materials to serve specific purposes and exhibit desirable properties. Composite materials are used in the form of monocoque structures in which lamiae of fiber reinforced polymer are bonded to each other. Considering this, structures are being invented in addition to monocoque structures and used in many applications such as in the aeronautical, automobile industries, defence applications. Therefore it is very essential to analyse composites for vibration analysis.This is a review paper. This evolves extensive experimental works to find the free vibration of woven fiber Glass/Epoxy composite plates in free-free boundary conditions. Proposed work is relatyed with manufacturing of composite specimensby the hand-layup technique. Elastic parameters of the plate will also determine experimentally by tensile testing of specimens. An experimental investigation will be carried out using modal analysis technique, to obtain the Natural frequencies. There should be validation of results obtained from the FEA using Ansys. The effects of different parameters including no. of layers and aspect ratio of woven fiber composite plates will be studied in free free boundary conditions in details. This study may provide valuable information for researchers and engineers in design applications.

Keywords: fiber reinforced polymer, woven fiber Glass/Epoxy composite, free-free boundary

I. INTRODUCTION

The thin lamination structure with less than 6mm is an important option and has the ability to change the body covers of automobiles owing to its superior strength and stiffness along with low weight per unit area. In field of aerospace industry, better drape ability of thin sandwich formation is preferred over thick conventional sandwich composites. Truck bodies and trailers use assemblies and parts made from reinforced plastics to a great extent. The use of light metals, which lends itself to simple shapes and extrudable forms, is also found to be economical. The low heat transfer coefficient of composites enables their use in refrigerated units. Glass reinforced polyester has all the properties that make it ideal for this purpose and has become the standard material.

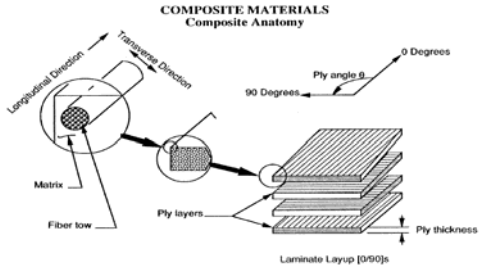

Fig no.1 Composite anatomy

Most of the fiber reinforced polymer (FRP) composite materials are used in the form of monocoque structures in which lamiae of fiber reinforced polymer are bonded to each other.Realizing this, structures are being invented in addition to monocoque structures.
These structures are found to be most influential in case of high stiffness and strength. Composites may be characterized as generally:

Anisotropic-There is no symmetric planes w.r.t the alignments of fibers. Fibers are arranged inthree- non mutual perpendicular direction

Monoclinic-There is one symmetric planes w.r.t the alignment of fibers.

Orthotropic -There are 3 mutually perpendicular symmetric planes w.r.t the alignment of fiber.

Isotropic-Every plane is a plane of symmetry. For example a composite containing a large no. of randomly oriented fibers behaves in an isotropic manner

II LITERATURE REVIEW

Cenk Aksoylar et al. (2011) [1] have discussed nonlinear transient analysis of FGM and FML plates under blast loads by experimental and mixed FE methods. Nonlinear transient behaviours' of fiber–metal laminated composite plates are investigated by both experimental and numerical techniques under non-ideal blast loads. In the experiments, three plates with different aspect ratios are tested and their responses are compared with both the developed mixed finite element method and the commercial software ANSYS. In the analyses with the developed mixed FEM, no condensation is performed hence time derivative of internal forces are also calculated. The results showed a good and reliable correlation between each other.

J. Suresh Kumar et al. (2011)[2] have investigated vibration analysis of composite laminated plates using higher-order shear deformation theory with zig-zagfunction. The ever increasing use of composite materials in advanced technology areas like aerospace, automotive, and sportsequipment's, have prompted to play a prominent role.

FarukFıratCalım (2009)[3] has intended to analyze free and forced vibrations of non-uniform composite beams in theLaplace domain. The free vibration is then taken into account as a special case of forced vibration. TheTimoshenko beam theory is adopted in the derivation of the governing equation. The material of therod is assumed to be homogeneous, linear elastic and anisotropic. The effects of shear deformation, rotaryinertia, non-uniformity of the cross-section are considered in the formulation.

K. Sepahvand et al. (2011)[4] have presented the theory and application of the generalized polynomial chaos expansion for the stochastic free vibration of orthotropic plates. Specifically, the stochastic analysis of orthotropic plates under the uncertainties in elasticity moduli is investigated. The uncertain moduli, Eigen-frequencies and Eigen-modes of the plates are represented by truncated polynomial chaos expansions with arbitrary random basis.

B. N. Singh (2009) [5] has developed composite plates to find out the non-linear free vibration response of composite laminates for different thickness and amplitude ratio. The used methodology is higher order deformation theory (HSDT) and MATLAB computation.

M. Barbato (2009) [6] has investigated a new simple and efficient two dimensional frame finite element able to accurately estimate the load carrying capacity of reinforced concrete beams flexurally strengthened with externally bonded fibre reinforced polymer(FRP) strips and plates. The input parameters were different loading conditions and output parameters were failure modes i.e. concrete crushing, reinforcing steel yielding, FRP rapture, FRP debonding. He was able to accurately simulate the response of RC beams flexurally strengthened with externally bonded FRP strips/ plates.

Thuc Phuong Vo et al. (2009) [7] have developed a geometrically nonlinear model to study the flexural–torsional behaviour of general thin-walled open-section composite beams with arbitrary lay-ups under various types of loadings. This model was capable of predicting accurately nonlinear flexural–torsional response for various configuration including boundary conditions and laminate orientation of thin-walled composite using incremental Newton–Raphson method, Von Karman formulation.

F. Moleiro et al. (2009)[8] have developed Layer wise finite element models, based on a mixed least-squares formulation for both static and free vibration analysis of multilayered composite plates. Input parameters were displacements, transverse stresses and in-plane strains. Used methodology was C^o continuous function. Due to the least-squares formulation, the model for static analysis yields asymmetric positive definite system of linear equations, whereas the model for free vibration analysis yields a symmetric quadratic eigen value problem.

Zhigang Yu et al. (2010)[9] have developed Formulations of a multivariable hierarchical beam element for static and vibration analysis based on the generalized variational principle with two kinds of variables. The present method has very high accuracy for the two kinds of

independent variables simultaneously, especially for the generalized forces.

O.A. Ganilo (2010)[10] has discussed an analytical model for the vibration of composite plate containing an embedded periodic shape memory alloy structure. The work was presented in this paper an effective approximate analytical model has been developed and analysed, as well as a numerical solution generated for comparison purposes. The general solution obtained in this paper can be applied also in the case of time variant damping.

III PROBLEM DEFINATION

The literature review is devoted to the recently developed finite elements based on various laminated plate theories for the free vibrations and dynamics, buckling, post buckling analysis, geometric non linearity, large deformation analysis, damage analysis of composite material. Most structural composite structures are subjected to dynamic loading in their working life & maximum damage results from the resonant vibrations. Maximum amplitude of vibration must be limited for the safety of the structure. Hence vibration analysis has become very important in designing structure to know it's response in advanced and to take the necessary steps to control the structural vibrations.

Proposed Work-

A Objectives

- A mathematical model is developed which is based on assumptions. The mathematical expressions based on differential equations and given conditions. These equations are very difficult to solve. Therefore the basic objective is to find out simple numerical solution technique.
- Composite materials are two or more distinct phase materials. Considering these to study the composite materials in depth is the objective.
- Fabrication method is the big concern related with the composite structures.

B. Methodology

- Develop fabrication method to fabricate test specimen

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- Proper experimental plan for testing

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- Analytical study by using Ansys

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- Theoretical and mathematical study to validate results

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- DOE study to optimize result

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- Validation of all results

IV CONCLUDING REMARK

Literature review is focused on the different types of analysis of composite materials. Due to the requirement of high performance material in aerospace and marine structures, the prospect of future research of composite material, such as FRP (Fibre Reinforced Plastic) is very bright. Analysis of natural frequency and properties of composite plate has started from 40 years ago.

The affects of different parameters on natural frequency is important analysis. The main factors or parameters which affect on vibration in case of composite laminated plates are unexplored.

As the composite material are made of two or more distinct phase materials. Manufacturing consideration plays an important role in design part. Therefore it is necessary to analyse the affect of different fabrication factors such as curing time, curing temperature and volume fraction ratio so as to optimise the fabrication process.

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